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ABSTRACT:

CHG DATE=19990902 STATUS=O> Planar transformer equipped with means (7, 8, 9)

for the extension of the air path of a hypothetical electric spark caused by
the irregular working of the planar transformer. <IMAGE>

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(54) Planar transformer

(57) Planar transformer equipped with means (7, 8, 9) for the extension of the air path of a hypothetical electric spark caused by the irregular working of the planar transformer.

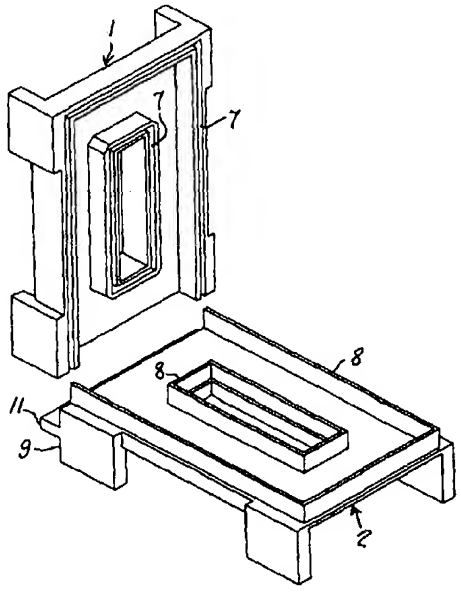

Fig 2

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Description

[0001] The present invention refers to a planar transformer to be used in applications where compactness and small overall dimensions are required, for instance in electronic circuits for computers or in the biomedical field.

[0002] It is known how to carry out planar transformers having small dimensions, said transformers being characterised in that they have a primary coil and one or more secondary coils in the form of copper printed circuit boards. Such copper circuits have a small thickness and therefore allow to reduce the known consequences deriving from the proximity between two conductors and the so-called skin effects, that is, the tendency of currents to flow near the surface of the copper conductor, thus increasing, in a known way, its resistance. Such known planar transformer substantially includes: a core made of ferromagnetic material consisting of two separate E-shaped portions used for the assembly and disassembly of the transformer itself; a copper printed circuit board, constituting the primary coil; two copper printed circuit boards, each representing one half of the secondary coil; a lower shell and an upper shell made of an insulating plastic material, whose function is to insulate the board of the primary coil from the two boards of the secondary coil, such boards being respectively located in the inner housing formed by the two shells placed one onto the other and on the outer surfaces of said shells; and plate insulators located on the lower and upper surfaces of the board of the primary coil and of the boards of the secondary coil.

[0003] From the previous description it is possible to observe the presence of various insulation means (shells and insulators) located within the planar transformer, this being due to the necessity to satisfy at the same time both the need for limited overall dimensions and the need for an effective electric insulation between the board of the primary coil and the boards of the secondary coil placed very near one to the others. The proximity between the board of the primary coil and the boards of the secondary coil gives the planar transformer effective features of electromagnetic coupling, it can however create disadvantages in case of irregular working of the transformer, for instance a spark caused by a discharge of excess current flowing from the board of the primary coil to the board of the secondary coil, which can cause an unwanted and dangerous electric contact between said boards; such discharge will go through the planar transformer by the so-called air path, which, given the limited dimensions of the transformer, will be relatively short and will face a lower resistance, for instance, between the connecting junctions of the two lower and upper insulation shells of the transformer. According to the security standards for this kind of planar transformers, there should be the adoption of safety measures allowing to increase the air path of a hypothetical spark caused by an electric discharge and then to help its quenching before it goes through the whole transformer from the board of the primary coil to the board of the secondary coil.

[0004] It is known how to carry out flanges made of insulating material, which are located on the sides of the planar transformer, so that in case of irregular working a spark caused by an electric discharge resulting from the board of the primary coil has a longer air path, thus having enough time to die out before reaching the board of the secondary coil. Such lateral flange made of insulating material, however, is disadvantageous, as it increases the lateral overall dimensions of the planar transformer, thus limiting its applications since, as was mentioned before, this kind of transformers is used, thanks to their compactness, in those fields of technology (computer science for instance) where the available free room is rather limited.

[0005] The present invention, therefore, provides a planar transformer equipped with means for the extension of the air path of a hypothetical spark caused by an electric discharge resulting from the printed circuit board of the primary coil, without increasing the overall dimensions of the planar transformer. In the planar transformer according to the present invention the upper and lower shells made of insulating material, which separate and insulate the boards of the secondary coil from the board of the primary coil, will be joined during the assembly of the transformer, by introducing one or more frames located on the upper surface of the lower shell in respective grooves located on the lower surface of the upper shell and, moreover, such transformer is provided with a vertical strip made of insulating material having a suitable size, said strip constituting an extension of the lateral wall of the lower shell, where the contact box of the transformer is located, without increasing the overall dimensions of the transformer.

[0006] The present invention will be better understood by means of the following description with reference to the enclosed drawings, where:

Figure 1 is a front view of a transversal section of a form of embodiment of the planar transformer according to the present invention;
Figure 2 is a perspective view of the upper and of the lower insulating shells according to the form of embodiment of the planar transformer of Figure 1;
Figure 3 is a partial front view of a transversal section of another form of embodiment of the planar transformer according to the present invention; and
Figure 4 is a partial lateral view of a longitudinal section of the planar transformer according to the present invention.

[0007] Figure 1 shows a form of embodiment of the planar transformer according to the present invention in cross section; as can be noticed, it consists of an upper shell 1 made of insulating material, which is introduced onto a lower shell 2, also made of insulating material,

said shells having the function of separating the printed circuit board 3 of the primary coil, equipped with plate insulators 4, from the printed circuit boards 5 of the secondary coil, also equipped with lamellar insulators 6. The upper shell 1 is provided, on its lateral walls, with one or more grooves 7 (one only in the form of embodiment shown in the figure), into which the relief frame 8, located on the upper surface of the lower shell 2 of the transformer, can be introduced. Such lower shell 2, moreover, is provided with a strip 9 representing an extension of the front lateral wall of said shell 2. As can be observed from the figure, the contact surface between the groove 7 of the upper shell 1 and the relief frame 8 of the lower shell 2 is greater than it would be if for instance such two shells 1 and 2 were placed one onto the other by means of the mere contact between the relief frame 8 against the inner lateral wall of the upper shell 2. Therefore, it can be inferred that, in case of irregular working of the transformer resulting in the creation of a spark caused by an electric discharge resulting from the board 3 of the primary coil, the length of the air path of said spark, represented by the interstitial space between the frame 8 and the groove 7, greatly increases, thus leaving the spark a longer quenching time which prevents its reaching the board 5 of the secondary coil, thus avoiding an unwanted and dangerous electric contact between the boards 3 and 5. Once the two shells 1 and 2 have been joined, the introduction of the core 10 made of ferromagnetic material can follow, said core consisting, as is known, of two separate half-cores 1001 and 1002 having the characteristic E-shape.

[0008] Fig. 2 shows the upper insulation shell 1 and the lower insulation shell 2 of the boards 3 and 5, respectively belonging to the primary and to the secondary coil; as can be observed, there is only one groove 7 in the upper shell 1, and, therefore, there is only one relief frame 8 on the upper portion of the lower shell 2, said frame being suitable to be introduced into said groove 7. Such relief frame 8 and the related groove 7 are open in the front part of the planar transformer, so as to allow the printed circuit board 3 of the primary coil, introduced inside between the two shells 1 and 2 placed one onto the other, to be connected to the contact box 11.

[0009] Fig. 3 shows, in cross section, the planar transformer of the present invention according to another form of embodiment. Differently from the form of embodiment of Figure 1, it is possible to observe two grooves 7 on the lower surface of the upper insulation shell 1 and two relief frames 8 on the upper surface of the lower insulation shell 2. As a matter of fact, as was previously mentioned, there can be more than one of said grooves 7 and relief frames 8, in accordance with the need not to increase the lateral overall dimensions of the planar transformer, such dimensions being, as was said, an important parameter for the application fields of such transformers. As can be observed from the figure, the contact surface between the lateral walls of the two shells, upper 1 and lower 2, is further increased with respect to the form of embodiment of Figure 1; it can be inferred that the air path of a hypothetical spark resulting from a current discharge coming from the board 3 of the primary coil because of the irregular working of the transformer is increased, so that also the available time for that spark to die out before reaching the board 5 of the secondary coil is further increased.

[0010] Figure 4 shows another means 9 for the extension of the air path of a hypothetical spark resulting from the irregular working of the transformer, such means 9 consisting of a strip 9 made of insulating material, located on the front wall of the planar transformer under the contact box 11 of the printed circuit board 3 of the primary coil, coated with the lamellar insulators 4. Such spark, coming from the board 3 of the primary coil, will thus be forced to follow a trajectory along the surface of the strip 9, having good chances to die out before reaching the board 5 of the secondary coil, located on the lower surface of the lower insulation shell 2, thus making the planar transformer safer.

Claims

1. Planar transformer equipped with means (7, 8, 9) for the extension of the air path of a hypothetical electric spark caused by the irregular working of said planar transformer.

2. Planar transformer according to claim 1, characterised in that said means (7, 8, 9) for the extension of the air path include one or more grooves (7) on the lower surface of the upper insulation shell (1) of the transformer and one or more relief frames (8) on the upper surface of the insulation shell (2), said frames being introduced into said respective grooves (7).

3. Planar transformer according claim 1 and 2, characterised in that said means (7, 8, 9) for the extension of the air path include an extension strip (9) placed under the open lateral wall of said planar transformer, where the contact box (11) is located.

4. Planar transformer according to claim 2, characterised in that it includes two grooves (7) and two relief frames (8).

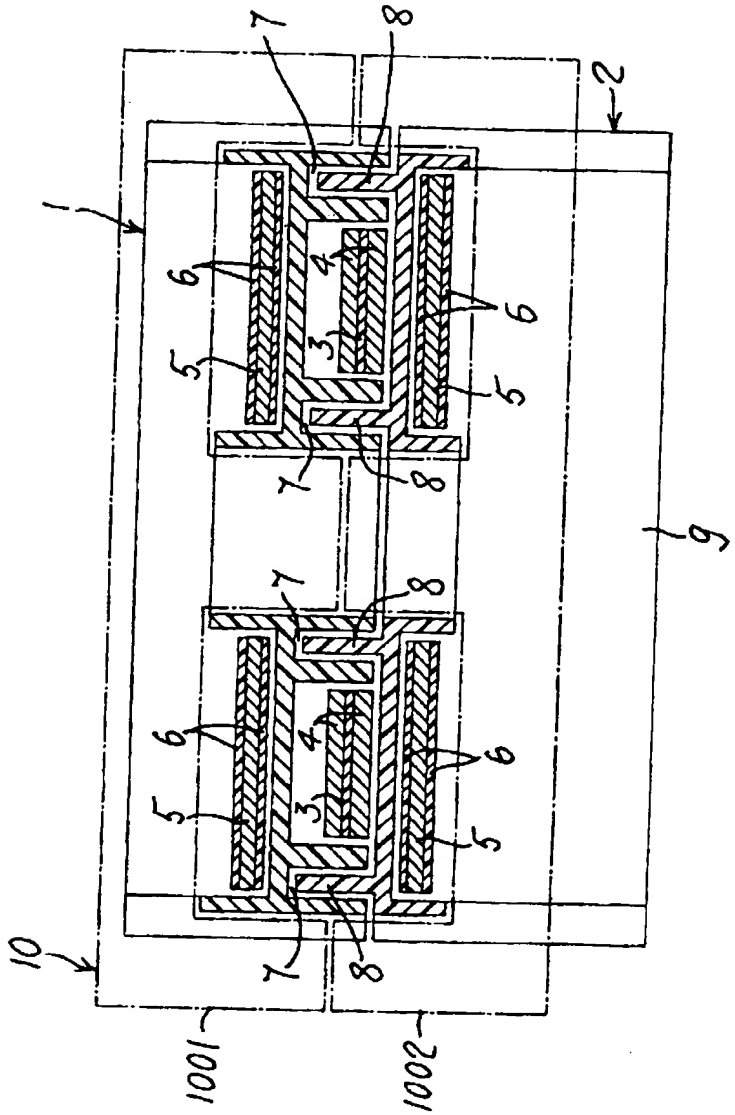

Fig. 1

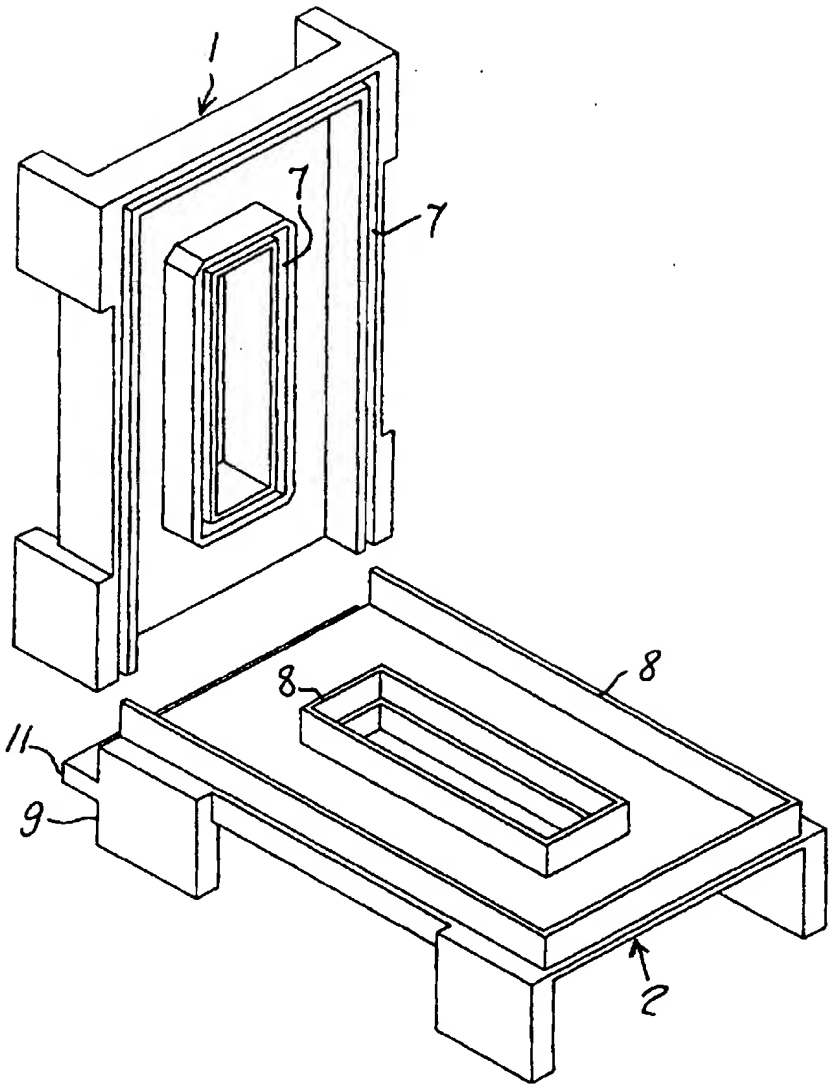

Fig. 2

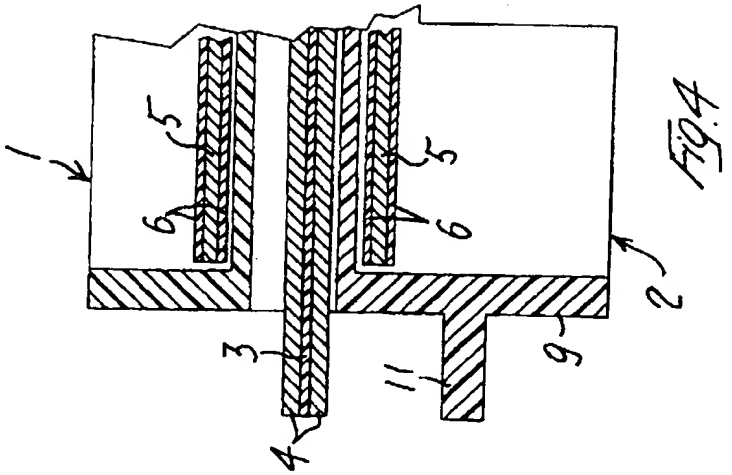

Fig.4

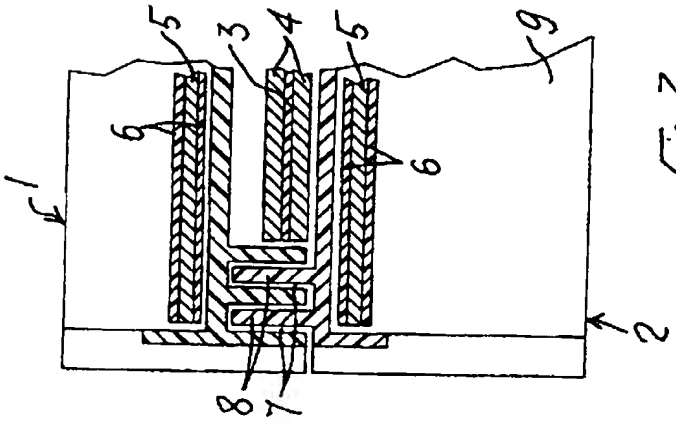

Fig.3